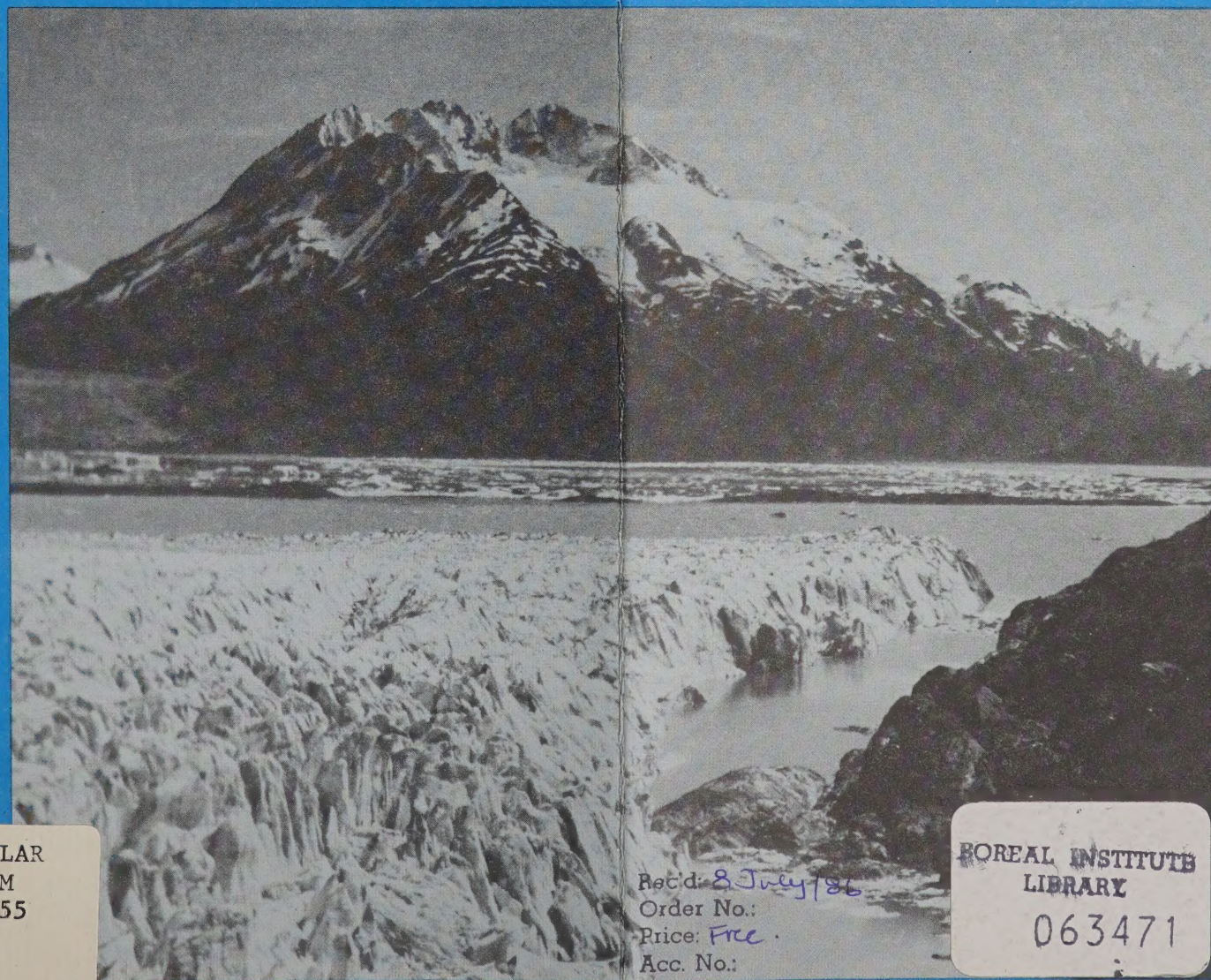


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THE BREAKOUT OF ALASKA'S LAKE GEORGE



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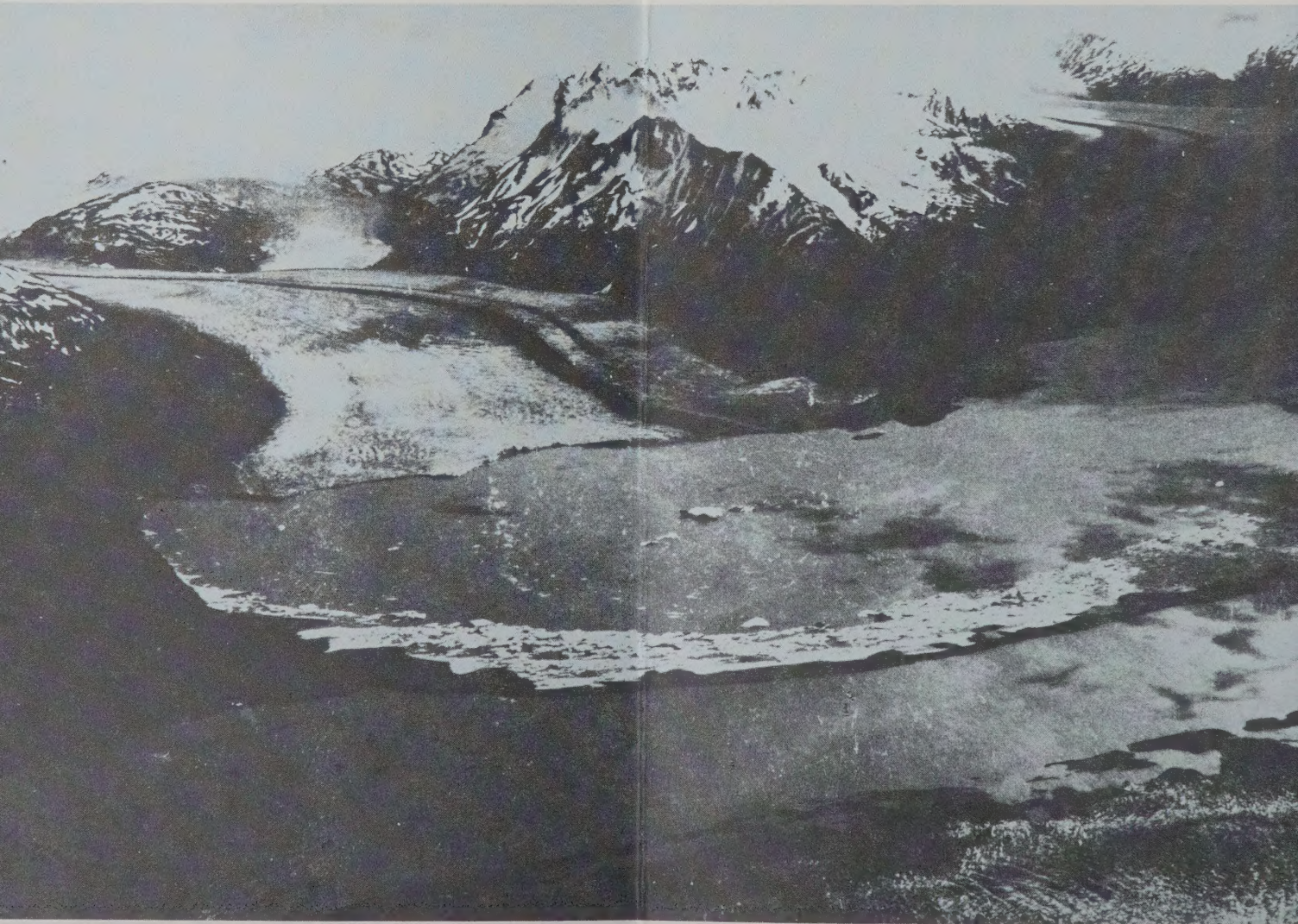
THE BREAKOUT OF ALASKA'S LAKE GEORGE

by Harry Hulsing

A spectacular hydrologic phenomenon, referred to as the "Breakout of Lake George," occurred in Alaska every summer for many years. Until 1967, Lake George periodically broke through its ice dam to release millions

of gallons of angry, surging water which roared down the Knik River Valley. The water was loaded with silt, debris, and glacial ice. Since 1967, the breakout and massive flooding have not been repeated, and until more hydrologic and other data are available, future breakouts cannot be predicted accurately. Nevertheless, the circumstances of Lake George's breakout are of considerable interest.

Breakout of Alaska's Lake George



About Lake George

Lake George, a seasonal lake that is one of the largest and most accessible of 53 known ice-dammed lakes in southern Alaska, lies in a 30-mile-long steep-walled valley in the Chugach Mountains about 45 miles east of Anchorage and 25 miles southeast of Palmer. At the head of the valley is Lake George Glacier; at the foot is Knik Glacier which, during some winters, presses a mass of ice 250 to 400 feet thick against Mount Palmer and seals the lake valley from its outlet to the Knik River.

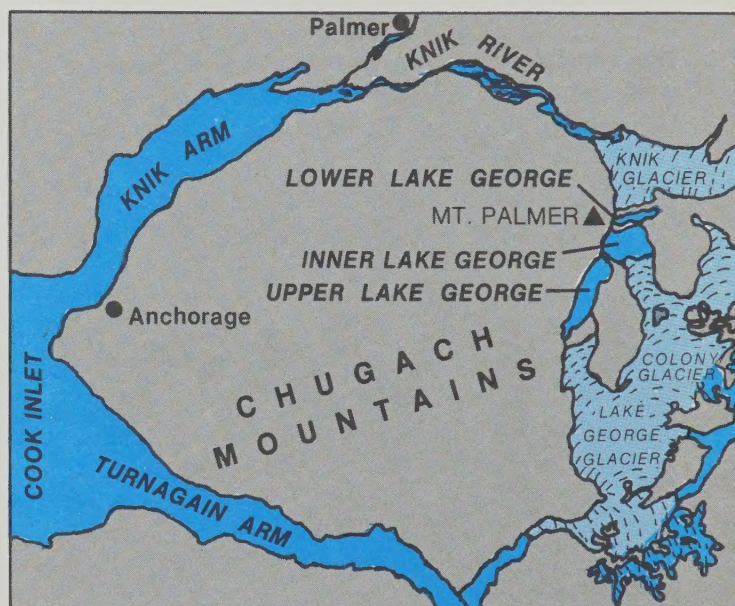
The valley of Lake George contains three shallow basins separated by ridges of glacial debris (moraines). These basins are fed in part by melt water from two large glaciers—Lake George Glacier and Colony Glacier—and numerous small glaciers. Some melt water from Knik Glacier also finds its way into the basins. During the fall and winter, when the water level is low, the basins form three lakes—Upper Lake George (8 miles long), Inner Lake George (4 miles wide), and Lower Lake George (2.7 miles long). Inner Lake George is the deepest, and during much of the year it is choked with icebergs broken off from Colony Glacier.

Location of Lake George



With the coming of spring, melt-water streams pour into the lake basins and fill them beyond capacity. As the waters of the three basins merge and as Knik Glacier moves enough to seal the outlet, Lake George is formed. At this time in the yearly cycle, Lake George is a body of water that may cover as much as 25 square miles and may rise 160 feet above its minimum level.

Lake George area

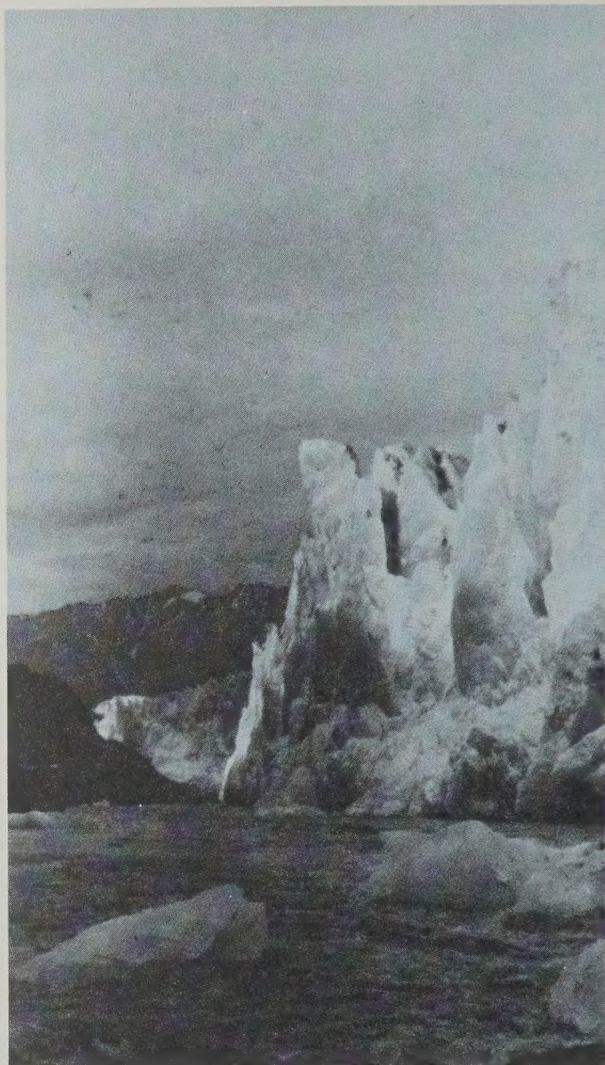
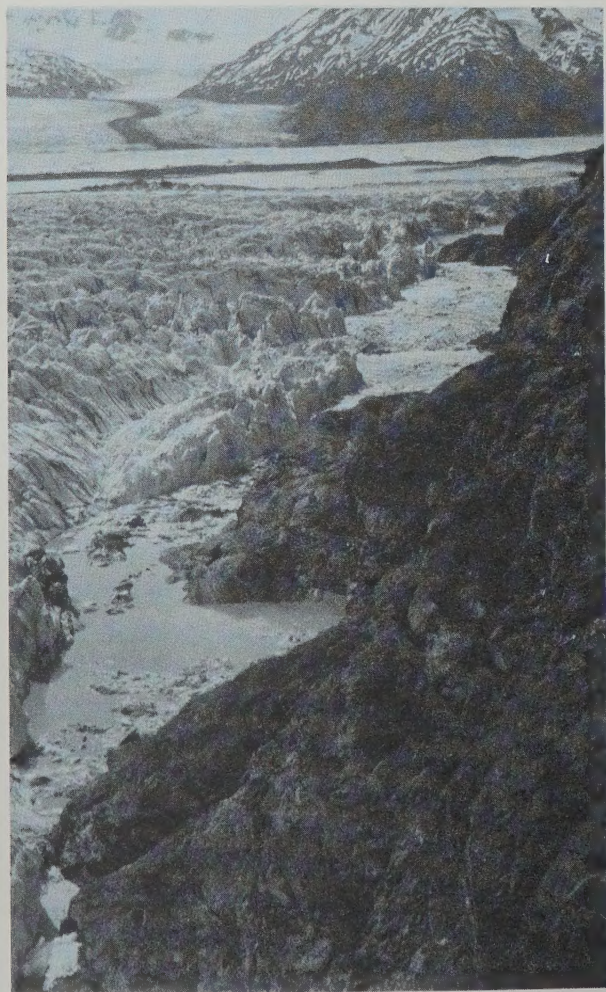


The Breakout

The breakout begins unobtrusively when water from the rising lake begins to seep slowly along the face of Knik Glacier at the point where the glacier presses against Mount Palmer. The stream finally breaks through the weakened ice dam, cutting an open channel—the Gorge—in the ice below the glacier and the mountain. Within a few days, this lake-fed stream becomes a raging torrent.

As the lake empties, the pressure of the water against the lower ice face becomes more intense, undercutting the ice face. This causes the overhanging sections of ice, some as long as a city block and as tall as a 15-story building, to fall with thunderous reverberations into the widening gorge below. Great surges of water caused by these ice falls rise as high as 150 feet.

View upstream showing the gorge formed between Mount Palmer and Knik Glacier.



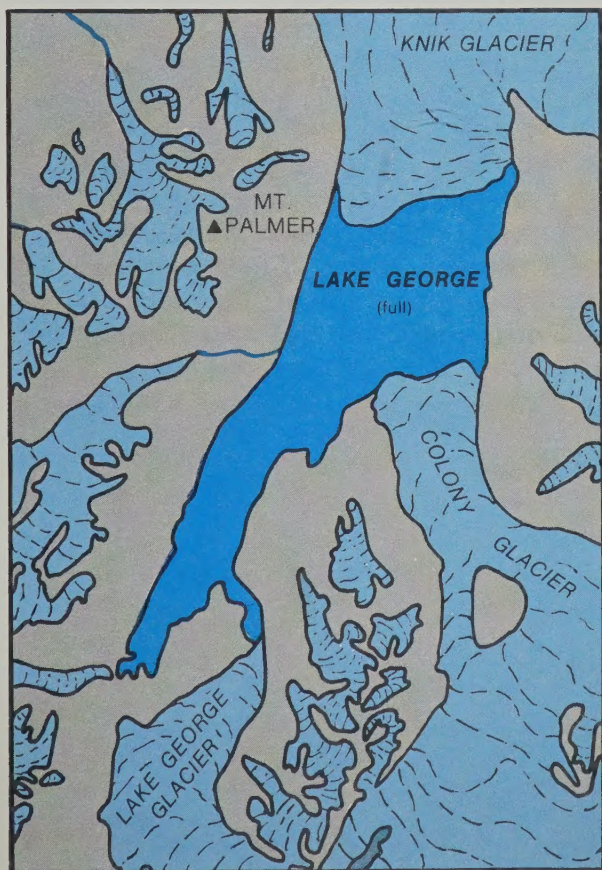
Downstream view of the face of Knik Glacier crumbling into the gorge

At the height of the flood, as much as 150 million gallons of water per minute roars through the gorge and spreads out over the usually peaceful Knik River Valley . When the flood has subsided, the gorge is about 5 miles long, from 100 to 400 feet wide and 300 feet deep, and extends to the base of the Knik Glacier.

Closing the gorge

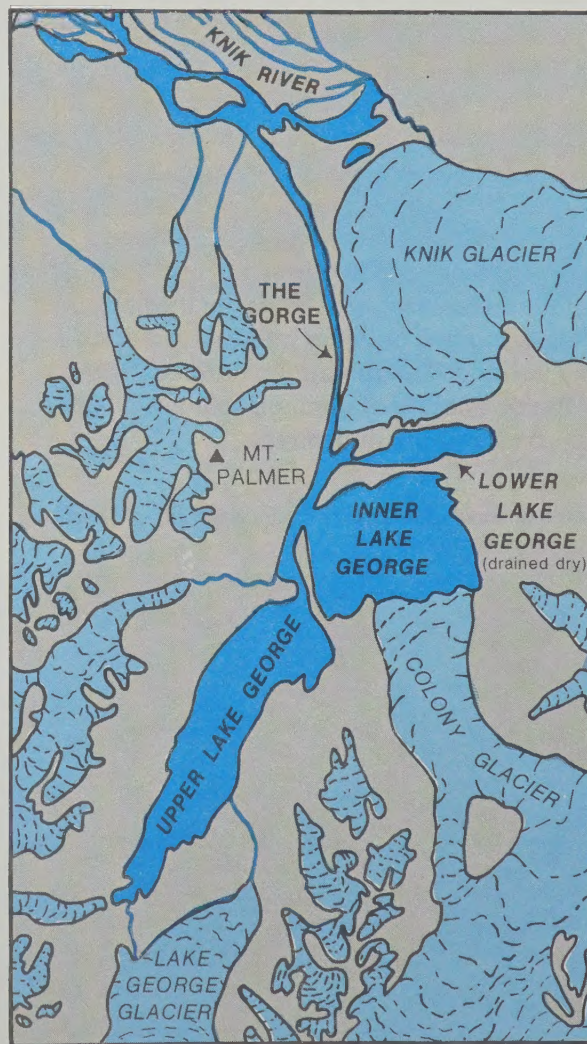
Twelve to fifteen days after the breakout begins, the lake is nearly empty. Streamflow persists, however, as the normal runoff from Lake George Basin continues to pass through the gorge. Eventually the flow slackens as the winter season approaches and the stream is no longer able to erode away the continually advancing edge of Knik Glacier. The glacier again moves into firm contact with the rocks of Mount Palmer, and no more water flows out from Lake George Valley. The breakout is over.

During the winter Knik Glacier presses a mass of ice 250-400 feet thick against Mount Palmer. This ice seals the lake basins from the Knik River Valley.



Because the valley is usually covered with snow during the winter, we cannot determine precisely when the gorge is closed. In 1963 and since 1967, a slight decrease in the rate of glacial advance has prevented formation of Lake George. Sufficient data is not available to predict when another breakout will occur.

As soon as flow through the dam is established, the water cuts a gorge through the ice at the base of Mount Palmer and Lake George breaks out.

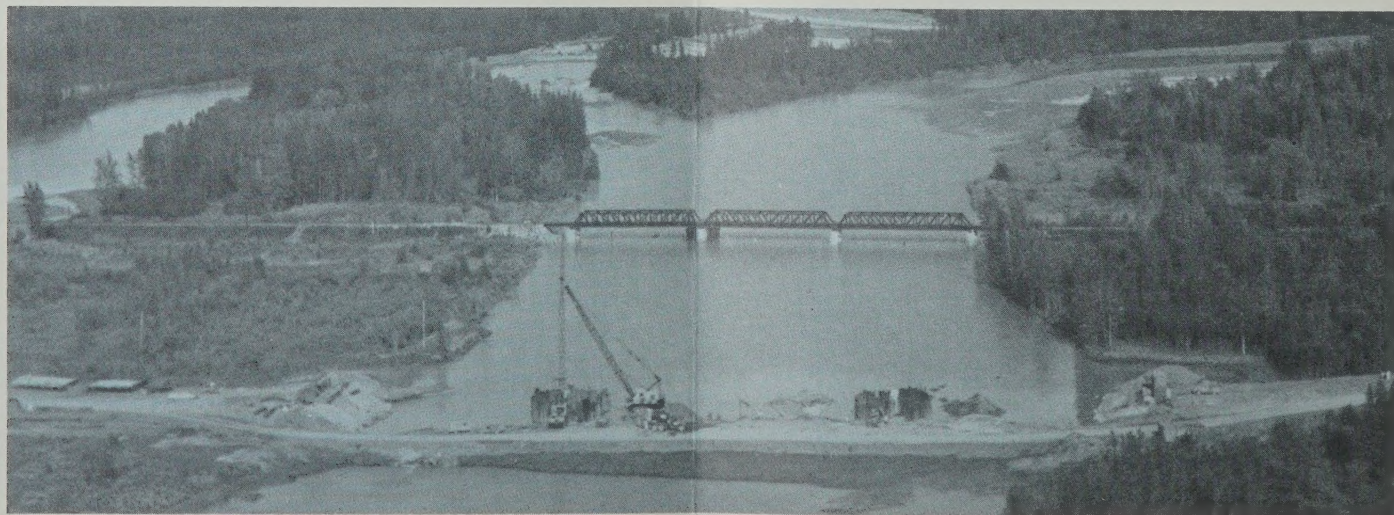


Flood damage

Just before 1900, three Indian villages along the Knik River were destroyed by a great flood that was probably the result of the breakout of Lake George. No previous damage along the Knik River had been recorded although, according to Indians living in the area, the lake emptied once every 15 or 20 years. Until about 1914, flooding and flood damage were irregular although a deep-water port at Knik on Knik Arm of Cook Inlet was silted up by one or more floods. After 1914, however, flooding became an almost annual threat to structures on the Knik River flood plain.

During the early 1920's, a relatively large settlement was planned at Matanuska, at the junction of the Alaska Railroad and a branch line to the Matanuska Valley coal fields. Over the years, flood damage caused by the breakout was so serious that by 1940 Matanuska was virtually abandoned. At present no large communities are threatened by these floods, although a few outlying homes are periodically flooded. The remaining serious problem is the possibility of damage to the Alaska Railroad and the highways.

Flooding along the Knik River Valley caused by the Lake George breakout.



Predicting the breakout

The annual threat to the railroad line across the Knik River flood plain induced the Alaska Railroad Commission to search for a way to predict the flooding. As a result, the Commission initiated a cooperative study with the U.S. Geological Survey. From 1958 to 1965, hydrologists of the Geological Survey made numerous measurements of the many factors that have a bearing on the timing of the breakout and on the intensity of flooding. The factors include the height of the ice dam, the maximum depth of Lake George, and the magnitude of the yearly floods as they pass the Geological Survey's stream-gaging station at the old highway bridge near Palmer.

The hydrologists learned that from the moment the water begins to trickle through fractures at the upstream end of the ice dam, several hours pass before the water becomes visible at the lower end of the gorge. It takes about 5 days for the flow through the gorge to reach its peak, and from 8 to 12 hours for this peak to travel from the lower end of the gorge to the gaging station, a distance of about 17 miles. In this 17-mile-long reach, part of the water overflowing the channel onto the gravelly flood plain is temporarily



Knik Glacier can be seen in the distance pressing against the base of Mount Palmer on the left. This downstream view shows all three basins of Lake George.

stored, and the peak flow is therefore reduced by about 10 percent between the time it leaves the gorge and the time it reaches the gaging station. This stored water returns to the main channel after the peak flow has passed and eventually it, too, flows past the gaging station.

With this knowledge, more accurate predictions of the time and magnitude of flooding are possible. Before this study, the Alaska Railroad maintained an emergency crew in the vicinity of Knik River, sometimes for several weeks, to combat the destructive effects of the flood. Now, with reasonable assurance that they can have several days advance warning, the emergency crew is not called upon until the flood is imminent.

Is Lake George Permanent?

Lake George, like all ice-dammed lakes, is a phenomenon not likely to last very long, at least not long in terms of geologic time. The balance between the advance of Knik Glacier and the accumulation of a large lake behind the ice dam is by nature a delicate one. Either of two events is likely to upset the balance: (1) If the climate warms appreciably or yearly snowfall decreases, Knik Glacier no doubt will retreat farther up-valley and in most years the ice dam will not form. (2) If the climate becomes colder or yearly snowfall increases, both Knik and Colony Glaciers may advance to fill most, or all, of the valley that now contains Lake George.

Lake George Breakout and Floods 1958-1980

Lake George

Maximum lake level

Flood crest of Knik River at Palmer Highway Bridge

Year of Record	Date of Breakout	Date Measured	Ft. above sea level	Fall in lake level (ft.)	Water released (acre-feet)*	Date	Height (ft.)	Rate of flow (ft ³ /s)**
1958	—	7/13	345.5	160	1,800,000	7/18	25.3	359,000
1959	6/26	6/26	300.2	115	900,000	7/1	20.8	223,000
1960	7/12	7/14	319.6	135	1,200,000	7/17	24.4	328,000
1961	7/20	7/23	326.7	142	1,400,000	7/26	24.3	355,000
1962	6/26	6/27	281.1	96	600,000	6/29	18.5	165,000
1963	No breakout—lake did not form—gorge remained open.							
1964	6/26	6/28	283.0	98	700,000	7/1	20.0	216,000
1965	7/8	7/9	290.0	105	900,000	7/11	21.4	236,000
1966	6/22	6/22	286.5	—	560,000	6/24	17.9	144,000
1967-80	No breakout—lake did not form—gorge remained open.							

*—One acre-foot of water is the amount that will cover an acre of ground to a depth of 1 foot. It is equal to 326,000 gallons.

**—One cubic foot per second (ft³/s) is equal to a flow of 449 gallons a minute.



After breaking out, Lake George, in the foreground, becomes shallow. Knik Glacier can be seen in the background. Mount Palmer is at the left.

The glaciers in this area have advanced and receded many times. The greatest advance came during the Great Ice Age (Pleistocene time, about 10,000 to 1 million years ago), when ice accumulated to such great thicknesses in the Cook Inlet region that it covered all but the highest mountain peaks. As the climate became warmer or drier, more ice melted in the summer than accumulated in the winter. The ice front generally receded and the ice mass thinned. During several decades before 1967, Knik Glacier was relatively stable, and Lake George continued its spectacular annual exhibition. There have been no breakouts since 1967, but a renewal of these awesome events may occur at any time.

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